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Polymeric nanocomposites coatings for the corrosion protection of steel

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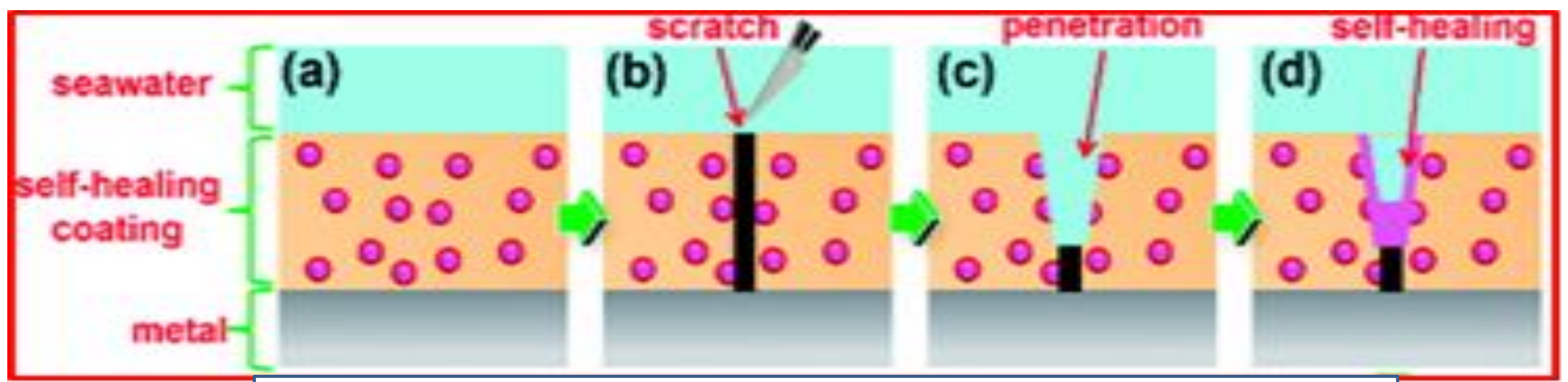
Introduction

Corrosion control is a current process for the prevention of metal deterioration in most industrialized countries. It has negative effect on production, processing, and transportation of several commercial products and equipment. Many researches and approaches were made to overcome the economic loss caused by corrosion. In the present work, new approach is used that depends upon the use of novel polymeric nanocomposite coating system with anticorrosive performance possessing corrosion sensing and self-releasing mechanisms .this smart coat can be synthesized and evaluated for its ability to protect steel from corrosion by acting as corrosion inhibitor and as self-healing agent

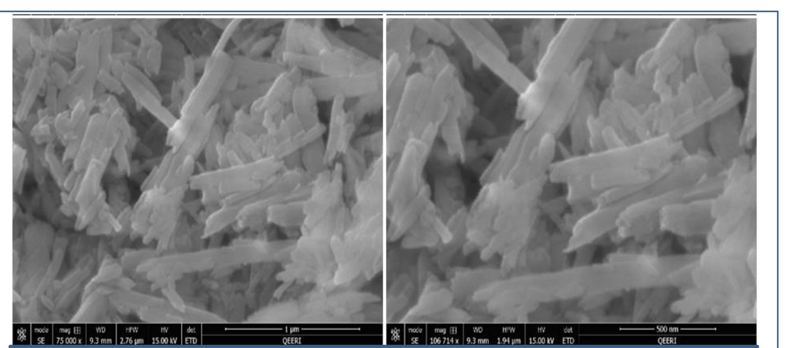


Schematic diagram showing self-healing technique

Results and discussion

1. Scanning electron microscope:

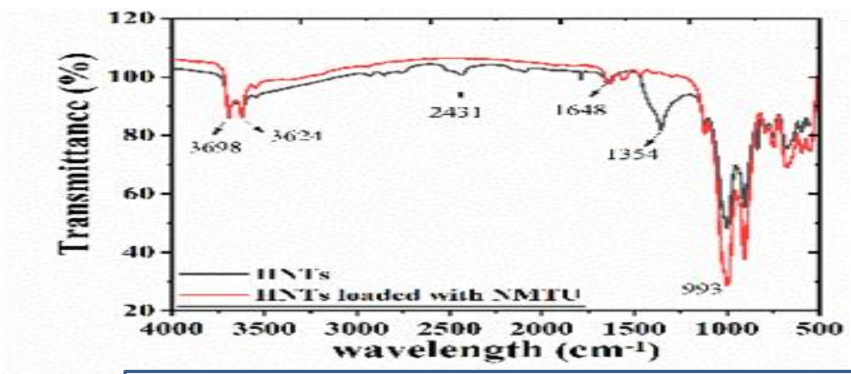
SEM results showing the smooth structure of the nano containers at different scales that ensures loading With the MTU



Picture of SEM results

2. FTIR (FOURIER TRANSFORM INFRARED SPECTROSCOPY):

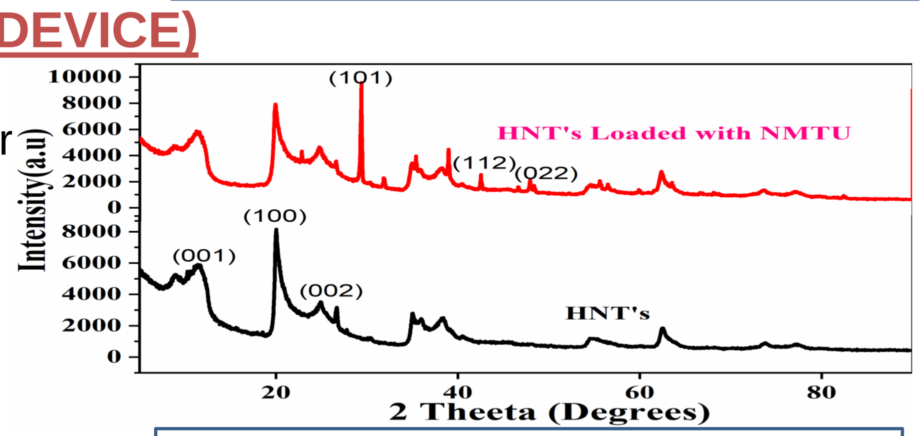
The change in the characteristic peaks observed for loaded product that indicates the loading of the inhibitor in HNTs.



Picture of FTIR results

•2. XRD (X-RAY DIFFRACTION DEVICE)

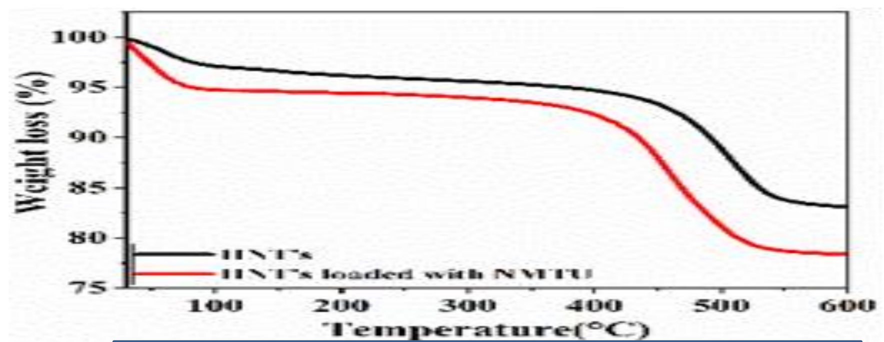
•- the black line is nanotubes alone
•The red line show that nanotubes wer



Picture of XTRD results

3. TGA (thermogravimetric analyzer):

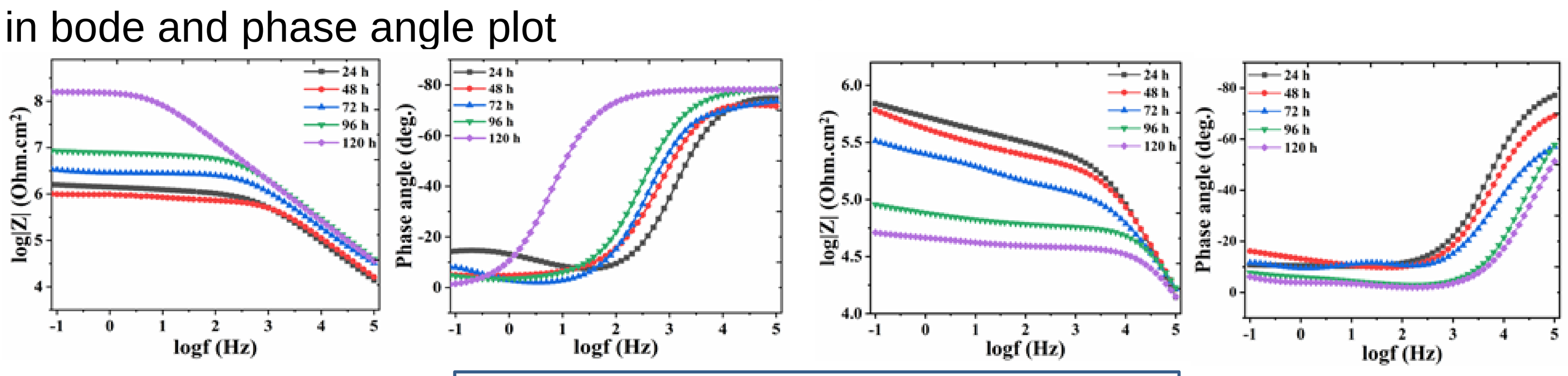
The initial weight loss till 100 °C is due to moisture content. Around 5% product of NMTU is successfully loaded inside HNTs.



Picture of TGA results

•3. Gamry 3300:

The EIS results showed the corrosion resistance of reference coatings **decreases** with time that can be shown in bode and phase angle plot The EIS results showed the corrosion resistance of modified coating **increases** with time that can be shown in bode and phase angle plot



Picture of EIS results

Experimental Steps

The procedure included 3 processes:

1. Loading process

NMTU + NANOTUBES = LOADED PRODUCT

a. Mixing 2gm of MTU and 1 gm of nanotubes with 10 ml water and stirring them by magnetic stirrer

a. Placing the sample in the vacuum chamber to help encapsulation of MTU into nanotubes for 24 hours

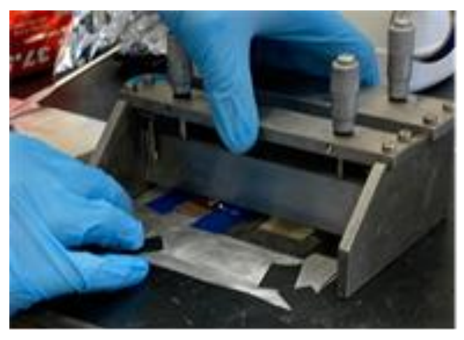
Picture Of vacuum chamber

a. Centrifuge for 15 min. using centrifuge device to separate the loaded product
b. Drying the sample in room temperature for 24 hours

2. coating process

a. Polishing of the steel substrate using polisher device

b. Mix 10 gram pf epoxy and 25gram hardener and1.25 gram loaded product



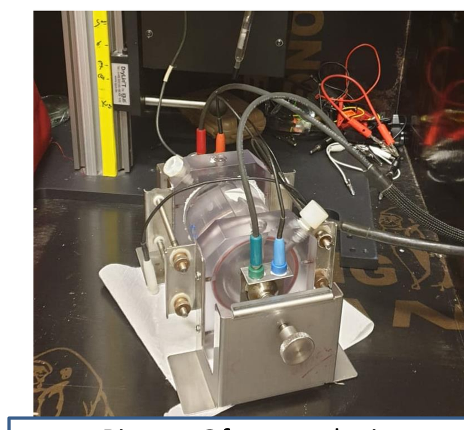
Picture Of coating process

C. Removing bubbles in the sample Using ultrasonic bath
D. Coating the steel substrate with the sample

3. Testing process

a. Structural characterization using SEM, FTIR, TGA and XRD

b. Corrosion testing using GAMRY 3300 device to measure the corrosion resistance



Picture Of gamry device

Conclusions Recommendations

The encapsulated active material (NMTU) was released gradually from the nanotubes after the scratch was formed, which begin to self-heal and resist the corrosive environment (as shown in EIS results)

This ensures the ability of NMTU to perform corrosion inhibition and self-healing on the surface of steel substrate, protecting it from corrosion. This consequently emphasizes the research hypothesis that the new nanocomposite smart coating is able to protect the steel from corrosion.

future researches for the development of new loaded inhibitors nano containers of higher performance and more environmentally friendly is highly recommended. Also it is recommended to try these smart coatings in different applications in(Oil and gas, Automotive, Aerospace, Textile, Manufacturing, Electrical fields) and further studies could be made under various corrosive conditions.

Scientific advances for performance assessment can result in an increase in reliability and safety, reduction in costs, and conservation of materials and energy

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